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☒ Oral presentation

☐ Poster presentation

Topology Optimisation of Thermomechanical Functionally Graded Materials and Material Interfaces

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Abstract

The work applies topology optimisation to the design of functionally graded materials (FGMs) and material interfaces for thermomechanical problems. It is well known, that the mismatch in stiffness and thermal expansion coefficient of two materials give rise to high stresses at the interface. One way to alleviate this is to use the concept of FGMs [1]. The FGMs are here designed using topology optimisation, which is a material distribution method used for finding an optimal structural layout for a given problem subject to design constraints [2]. Density-based multi-material topology optimisation is utilised to optimise the material composition and distribution in order to achieve a high thermal throughput, while maintaining an acceptable stress level.

The work considers the design of local material microstructures with the objective of optimising the macrostructural response. In contrast to homogenisation techniques, connectivity among the local microstructural cells is ensured by analysing the full macrostructure with all microstructural details being fully-resolved by the finite element method. This is computationally challenging and the work will therefore explore the use of a coarse-scale spectral preconditioner [3] to the coupled thermomechanical problems.

The problems investigated are inspired by those of plasma facing components (PFCs), thermal barrier coatings (TBCs) and thermal protection systems (TPSs).

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Keywords: topology optimisation, thermomechanical, functionally graded materials, material interfaces, stress constraints

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